1-G-30

DANA™

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PRELIMINARY AMPLIFIER TEST PROCEDURE

DANA MODEL 2195

AMPLIFIER TEST PANEL

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1.0 TEST EQUIPMENT

1.1 Hewlett-Packard Model 130C Oscilloscope, or equivalent.

1.2 Hewlett-Packard Model 200CD Oscillator or equivalent. The oscillator should be capable of delivering a 30 volt peak to peak signal from d.c. to 25 KC with a 600 ohm load.

1.3 Hewlett-Packard Vacuum Tube Voltmeter-Model 400LR or equivalent. The 400LR has an expanded decibel scale and is preferable for reading the frequency response of the Dana Amplifier.

1.4 D.C. Millivoltmeter (Optional)

1.5 Hewlett-Packard Attenuator Box, Model 350D (Optional)

2.0 GEN-EXT SWITCH (TOGGLE)

The "GEN" - "EXT" Switch selects a generator connected to the "GEN. INPUT" jacks or a generator connected to the "EXT. INPUT" jacks in the "GEN. INPUT" position, the generator connected to the ATTENUATOR and the scope horizontal.

2.1 ATTENUATOR

The Attenuator is a high precision resistive voltage divider using .1% precision wirewound resistors. It offers a constant input impedance (600 ohms) to the oscillator and a constant output impedance to the input of the amplifier.

2.1.1 The "Attenuator" rotary switch selects the desired attenuation.

2.1.2 The "Variation" potentiometer is a vernier adjustment for the fixed attenuation when the "Fixed/ Variable" switch is placed to the "Variable" position.

2.1.3 The FIXED - VARIABLE switch is used for a fixed attenuation in the FIXED position. In the VARIABLE position, the attenuation may be varied with the variation dial. The variable position nulls the amplitude error of the lissajous figure displayed on the oscilloscope.

2.2 INPUT MODE

2.2.1 The Input Mode switch selects the input to the amplifier - shorted input, non-inverting input or inverted input.

2.2.2 CM

The common mode position is used for checking the common mode rejection of the amplifier by applying a signal from common to the shorted inputs of the amplifier.

2.3 SOURCE UNBAL

The "Source Unbalance" switch (outer knob) is used to select no resistor in the shorted position, a series resistor in series with the P-input or N-input of the amplifier, or a resistor in series with both the P-input and the N-input. The inner switch selects the resistor value.

2.4 INPUT MODE

Momentarily shorts the P, N and Guard inputs to common by pushing the lever to the left.

2.5 GUARD

The Guard - ON, OFF switch connects or disconnects the guard of the amplifier to the guard within the test panel.

2.6 LOAD

The Load Switch is a two wafer switch, independent of one another, which selects one of eight resistors and/or one of six capacitors across the output of the amplifier. By placing the outer knob to the "EXT LOAD" position, a load across the output of the amplifier may be inserted at the "EXT LOAD" jacks.

2.7 OUTPUT MODE

2.7.1 NOR AMP- connects the VTVM and the scope to the wideband output of the amplifier. (Dana Series 3000, Series 2800, and Series 2600).

2.7.2 BUF AMP - connects the VTVM and the scope to the variband output of the amplifier. (Dana Series 3000, only)

2.7.3 BUF ZERO - connects both the variband and the wideband outputs together. The measured voltage should very nearly be zero. (Dana Series 3000, only).

2.7.4 CMN - used on the Dana Model 3640, only.

This position is used to measure the interaction between outputs by applying a common mode voltage to the common lead of the variband output and measuring the common mode rejection of the wideband amplifier.

2.7.5 CMB - Used on the Dana Model 3640, only.

This position is used to measure the interaction between outputs by applying a common mode voltage to the common lead of the wideband amplifier and measuring the common mode rejection of the variband amplifier.

2.8 FILTER

2.8.1 The filter switch selects one of five different filters at the output of the amplifier - 100 kHz, 10 kHz, 1 kHz, .1 kHz, or .01 kHz. In the "direct" position, the output of the amplifier is connected directly to the "output selector" switch.

2.8.2 RATIOMETER - The ratiometer position switches the output of the amplifier to the "ratiometer" jacks.

2.9 OUTPUT SELECTOR

2.9.1 AMP OUT - connects the measuring equipment to the amplifier output to be measured.

2.9.2 NULL - connects the measuring equipment to the output of the null detector.

2.9.3 ATTEN IN - connects the measuring equipment to the input of the attenuator.

2.10 NULL DET - nulls the quadrature error of the lissajous figure displayed on the oscilloscope when the output selector switch is in the null position.

2.11 INPUT SELECTOR -

2.11.1 INT AMP - selects the circuits in the model 2195 Test Panel.

2.11.2 EXT. AMP - selects an external input to the amplifier. The external input is connected to the "EXT. AMP INPUT" jacks.

3.0 INITIAL CHECKOUT

The simple tests described are generally sufficient to check out the instrument on receipt. The purpose of these tests is only to establish that the amplifier is in operating condition. The procedure should not be confused with the more elaborate specification checks which the user may want to perform before he actually puts the amplifier into use.

Only two pieces of test equipment are required to conduct checkout tests:

Audio Oscillator
Oscilloscope

3.1 Connect the power cord at the rear of the test panel to 105-125 volts rms, 50 - 400 cps.

3.2 Connect the oscillator to the "GEN INPUT" jacks.

3.3 Connect the "SCOPE VERT" jacks to the oscilloscope vertical inputs. Connect the "SCOPE HOR" jacks to the oscilloscope horizontal inputs.

3.4 GAIN

3.4.1 Set DUAL output variband models to maximum bandwidth.

3.4.2 Set the amplifier gain control to the highest gain position (normally 1,000).

3.4.3 Note that the Test Panel POWER Switch is in the OFF position before connecting or removing the amplifier from the interconnecting cable to the Test Panel. Serious damage to the terminals of the amplifier may result due to the arcing of the line voltage.

3.4.4 Connect the amplifier to the test panel and turn the POWER switch to ON.

3.4.5 Adjust the Attenuator for a FIXED attenuation of 1000.

3.4.6 GEN - INT.

3.4.7 INPUT MODE - NON INV.

3.4.8 SOURCE UNBAL - SHORT

3.4.9 GUARD - ON

3.4.10 LOAD - OFF

3.4.11 OUTPUT MODE - WIDEBAND

3.4.12 FILTER - DIRECT

3.4.13 OUTPUT SELECTOR - ATTEN IN

3.4.14 If the amplifier has a "gain" multiplying vernier, turn the screwdriver adjustment to minimum (extreme counter-clockwise).

Do not turn the "zero" screwdriver adjustment.

If the unit has a X1, X0.01 gain multiplier, set to X1.0.

3.4.15 Adjust the oscillator for 20 volts peak-peak at 100 cps or any other convenient low frequency. Monitor on the oscilloscope.

3.4.16 OUTPUT SELECTOR - AMP OUT

3.4.17 The oscilloscope should indicate approximately the same value, 20 volts,* as when connected directly to the oscillator. The term "approximately" is used because of limited capability of an oscilloscope to compare two magnitudes accurately.

There should be no obvious noise or unexplained distortions in the oscilloscope trace.

3.5 FREQUENCY RESPONSE

3.5.1 Change the oscillator frequency to 20,000 cps and repeat Paragraph 3.4.13 and Paragraph 3.4.15.

3.5.2 Repeat Paragraph 3.4.17.

3.5.3 The difference in the voltage, compared to that in Paragraph 3.5.1, should be no more than $\pm$ 1 db, or approximately 10%.

3.5.4 For models with variable bandwidth proceed as above with the OUTPUT MODE switch in the VARIBAND position. Response should be -6db $\pm$ 1db at cutoff frequency, decreasing at 12db/octave at higher frequencies on each of the bandwidth settings provided on the front panel of the amplifier.

* For F-options, adjust the "gain" vernier to the values recorded in Paragraph 3.4.15.

A Hewlett Packard VTVM Model 400LR may be used to read decibels directly by connecting the jacks marked "EXT. LOAD" to the input of the meter.

3.6 COMMON MODE REJECTION

3.6.1 INPUT MODE - CM

3.6.2 GUARD - ON

3.6.3 LOAD - OFF

3.6.4 FILTER - 1 kHz

3.6.5 OUTPUT SELECTOR - ATTEN. IN

3.6.6 OUTPUT MODE - WIDEBAND

3.6.7 Adjust the oscillator for 10 volts, peak to peak, at 60 Hz. Set the amplifier gain at 1000.

3.6.8 OUTPUT SELECTOR - AMP OUT

The common mode rejection may be calculated as follows:

$$CMR = \frac{10 \text{ volts} \times K}{\text{output voltage}}$$

K = gain of the amplifier (normally 1,000)

3.6.9 For dual output models repeat Paragraph 3.6 with the OUTPUT MODE selector in the "VARIBAND" position.

3.7 If the amplifier passes the simple tests outlined above, it is highly probable that it is fully functional.

4.0 OPERATING CHARACTERISTICS

4.1 Do not connect or disconnect the amplifier from the interconnecting cable to the test panel while the "POWER" Switch is in the "ON" position. Serious damage to the amplifier's terminals may result due to the arcing of the line voltage.

4.2. Connect the power cord at the rear of the test panel to 105-125 volts rms, 50-400 cps.

4.2.1 INPUT MODE - SHORT

4.2.2 SOURCE UNBAL - SHORT

4.2.3 GUARD - ON

4.2.4 GEN - GEN INPUT

4.2.5 LOAD - OFF

4.2.6 OUTPUT MODE - WIDE BAND

4.2.7 FILTER - DIRECT

4.2.8 OUTPUT SELECTOR - ATTEN IN

4.2.9 Connect the oscillator to the "GEN. INPUT" jacks. Paragraph 1.1.

4.2.10 Connect the "SCOPE HOR" jacks to the horizontal input of the oscilloscope.

4.2.11 Connect the "SCOPE VER" jacks to the vertical input of the oscilloscope. Paragraph 1.1.

4.2.12 Connect the input of the VTVM to the vertical input of the oscilloscope.

4.2.13 Connect the amplifier to the test panel and turn the "POWER" switch to "ON".

4.3 NOISE

4.3.1 Set the gain of the amplifier for a gain of 1000. Set the "OUTPUT SELECTOR" switch to the "ATTEN. IN" position.

4.3.2 Adjust the oscillator for 20 volts peak to peak at 100 cps or any other convenient low frequency. Monitor on the oscilloscope.

4.3.3 OUTPUT SELECTOR - AMP OUT

4.3.4 Record the peak to peak noise.

The RMS voltage referred to the input = 1/6 peak to peak voltage divided by 1000

or

Read the RMS voltage directly from the VTVM and divided by 1000

4.3.5 SOURCE UNBAL - P

Reference amplifier manual specifications for source unbalance resistance value. Repeat Paragraph 4.3.4.

4.3.6 SOURCE UNBAL - N

Reference amplifier manual specifications for source unbalance resistance value. Repeat Paragraph 4.3.4.

4.3.7 SOURCE UNBAL - SHORT

4.3.8 If the unit is a dual output, switch the "OUTPUT MODE" selector to "VARIBAND" and repeat Paragraph 4.3.4, Paragraph 4.3.6 and Paragraph 4.3.7.

4.3.9 Place the bandwidth selector on the amplifier to 10 Hz.

4.3.10 Record the noise as in Paragraph 4.3.4.

4.4 ZERO

4.4.1 OUTPUT SELECTOR - AMP OUT

4.4.2 FILTER - 1 kHz

4.4.3 OUTPUT MODE - WIDEBAND

4.4.4 Set the amplifier gain to 10.

4.4.5 Adjust the gain screwdriver adjustment on the amplifier for a minimum D.C. level as displayed on the oscilloscope. Record the residual offset.

4.4.6 Set the amplifier gain to 1,000.

4.4.7 The offset voltage should be equal to that recorded in Paragraph 4.4.5. For the zero adjustment of the amplifier, reference Paragraph 7.1.

4.5. LINEARITY

4.5.1 OUTPUT MODE - WIDEBAND

4.5.2 FILTER - OFF

4.5.3 LOAD

If the unit is a 10 ma model, place the LOAD switch to 1 k Ohm. If the unit is a 100 ma model, place the LOAD switch to 100 Ohms.

4.5.4 Set the ATTENUATOR for a FIXED attenuation of 1,000.

Set the amplifier gain for 1,000. Adjust the screwdriver gain adjustment on the front panel of the amplifier for minimum (extreme counter-clockwise). V options only.

4.5.5 OUTPUT SELECTOR - NULL

4.5.6 Set the scope horizontal sensitivity for 5 volts/cm and the scope vertical for 5 mv/cm.

4.5.7 INPUT MODE - NON INV

4.5.8 Null the quadrature error on the scope with the NULL DET. Adjust the gain vernier on the F-options until the display is horizontally flat. (Dana 3000 Series with F-option).

4.5.9 Place the attenuator "FIXED - VARIABLE" switch to the "VARIABLE" position. Null the amplitude error by turning the "VARIATION" potentiometer.

4.5.10 $$\text{Linearity (in \%)} = \frac{\text{peak null det reading (volts)} \times 100}{\text{full scale (20 volts)}}$$

4.5.11 Place the ATTENUATOR "FIXED-VARIABLE" switch to the "FIXED" position.

4.6. OUTPUT CAPABILITY

4.6.1 OUTPUT SELECTOR - NULL

4.6.2 Adjust the oscillator for 100 Hz and increase the amplitude to 25 v peak to peak. (Horizontal Deflection)

4.6.3 The lissajous figure on the oscilloscope should start to "break-up" beyond 25 volts peak to peak. For adjustment of the current limiting potentiometers, reference Paragraph 7.5.12.

4.7 FREQUENCY RESPONSE - WIDEBAND

4.7.1 Adjust the oscillator for 20 volts peak to peak at 100 Hz. (Horizontal Deflection). Place the LOAD switch to OFF.

4.7.2 Set the ATTENUATOR for a fixed attenuation of 1,000.

4.7.3 OUTPUT SELECTOR - AMP OUT

4.7.4 Increase the frequency of the oscillator to 20 kHz. The frequency response should be ± 1 db to 20 kHz.

4.7.5 Repeat the above tests for each gain setting of the amplifier.

4.7.6 For units with gains other than the normal options, such as specials, may be attenuated by selecting the "INT AMP" position on the "INPUT SELECTOR" switch and connecting an external voltage divider to the "EXT AMP INPUT" jacks.

4.7.7 Increase the frequency of the oscillator to 50 kHz. For each gain setting of the amplifier, attenuate accordingly. The frequency response should be ± 3 db to 50 kHz.

4.8 FREQUENCY RESPONSE - VARIBAND (dual output models, only).

4.8.1 OUTPUT MODE - VARIBAND

4.8.2 Repeat Paragraph 4.7.1 to Paragraph 4.7.7 with the bandwidth selector on the amplifier in the wideband (WB) position.

4.8.3 Set the bandwidth selector on the amplifier to 10 kHz. Response should be -6db ± 1 db at cutoff frequency, decreasing at 12db/oct ave at higher frequencies on each of the bandwidth settings on the front panel of the amplifier.

4.8.4 If the amplifier meets the specifications in Paragraph 4.8.3 at a gain of 1,000, it is not necessary to check each gain setting of the amplifier.

4.9 SMALL SIGNAL BANDWIDTH

Small signal bandwidth is measured by applying a 20db signal below

the gain of the amplifier. For instance, if the amplifier gain is 1,000, the attenuator should be set for 100.

4.9.1 The frequency response should be ± 3db at cutoff frequency for each setting of the bandwidth selector on the amplifier.

4.10 CAPACITIVE DRIVE

4.10.1 INPUT MODE - SHORT

4.10.2 Set the amplifier gain to maximum (normally 1000)

4.10.3 Set the ATTENUATOR to 1

4.10.4 FILTER - OFF

4.10.5 Set the vertical sensitivity of the scope to 5mv/cm.

4.10.6 OUTPUT SELECTOR - AMP OUT

4.10.7 Place the LOAD selector to one of six positions selecting a capacitor across the output of the amplifier. Reference specification in the amplifier manual for value of capacitance.

4.10.8 OUTPUT MODE - WIDEBAND

4.10.9 Adjust the oscillator for 20v p-p at 1 kHz.

4.10.10 Switch the INPUT MODE to NON INV and back to SHORT. The display on the scope should return to the initial display.

4.11 COMMON MODE REJECTION

4.11.1 Set the ATTENUATOR for a FIXED attenuation of 1,000.

4.11.2 FILTER - 1 kHz.

4.11.3 INPUT MODE - CM

4.11.4 Adjust the oscillator for 20 v peak to peak at 60 cps. Monitor on the scope by placing the OUTPUT SELECTOR to the ATTEN IN position.

4.11.5 OUTPUT SELECTOR - AMP OUT

4.11.6 Measure the amplitude of the lissajous figure. Reference Chart - A for the common mode rejection in decibels.

4.11.7 CMR - P Source

SOURCE UNBAL - P500 (110 db)

Repeat Paragraph 4.11.6

4.11.8 CMR - N Source

SOURCE UNBAL - N500 (110 db)

Repeat Paragraph 4.11.6

4.11.9 OUTPUT MODE - VARIBAND (dual output models, only)

4.11.10 Repeat Paragraph 4.11.7 and Paragraph 4.11.8

4.11.11 INPUT MODE - SHORT

4.11.12 OUTPUT MODE - CMN (Model 3640, only)

Repeat Paragraph 4.11.6

4.11.13 OUTPUT MODE - CMB (Model 3640, only)

4.11.14 Repeat Paragraph 4.11.6.

CHART A - Common Mode Rejection

Oscillator voltage - 20 volts peak to peak

$$db = 20 \log \frac{20 \times 10^3}{\text{output voltage}}$$

Millivolts (output)	Decibels
1	146.0
2	140.0
3	136.4
4	134.0
5	132.0
6	130.4
7	129.1
8	127.9
9	126.9
10	126.0
11	125.2
12	124.4
13	123.7
14	123.1
15	122.5
16	121.9
17	121.4
18	120.9
19	120.4
20	120.0

5.0 GAIN ACCURACY (V-Options)

5.1 Perform Paragraph 4.1 through Paragraph 4.2.13.

5.2 Adjust the oscillator for 20 volts peak to peak at 100 Hz.

5.3 OUTPUT SELECTOR - NULL

5.4 Set the ATTENUATOR for a FIXED attenuation of 1000.

5.5 Set the gain selector on the amplifier for 1000. Adjust the gain vernier to minimum (extreme counter-clockwise.)

5.6 INPUT MODE - NON INV.

5.7 Null the quadrature error with the NULL DET.

5.8 The vertical deflection on the scope should be a maximum of 20 millivolts (± .1% of 20 volts).

5.9 For each gain setting of the amplifier, set its equivalent attenuation with the ATTENUATOR in the FIXED position. For amplifier gains which can not be attenuated by the ATTENUATOR, reference Paragraph 4.7.6.

5.10 Repeat Paragraph 6.8 for each setting.

6.0 GAIN SETTING FOR F- OPTIONS (Dana Series 3000, only)

6.1 GEN - GEN. INPUT

6.2 INPUT MODE - NON INV

6.3 SOURCE UNBAL - SHORT

6.4 GUARD - ON

6.5 LOAD - OFF

6.6 OUTPUT MODE - WIDEBAND

6.7 FILTER - OFF

6.8 OUTPUT SELECTOR - NULL

6.9 ATTENUATOR

Set the ATTENUATOR for a FIXED attenuation of 1,000.

6.10 Set the amplifier gain switch at 1000.

6.11 Adjust the gain vernier on the amplifier until the display on the scope is horizontally flat. Null the quadrature error with the NULL DET.

6.12 Any gain on the amplifier may be set by switching the gain dial to a particular gain. Adjust the ATTENUATOR (FIXED) for an equivalent attenuation of that gain. Proceed as in Paragraph 6.11.

7.0 MAINTENANCE AND ADJUSTMENTS

7.1 COLLECTOR ZERO SET

7.1.1 Place the INPUT MODE selector to SHORT

7.1.2 Connect a jumper between the black terminal of "GEN. INPUT" and the black terminal of "WB" jack.

7.1.3 SOURCE UNBAL - SHORT

7.1.4 GUARD - ON

7.1.5 LOAD- OFF

7.1.6 OUTPUT MODE - WIDEBAND

7.1.7 FILTER - 1 kHz

7.1.8 OUTPUT SELECTOR - AMP OUT

7.1.9 Connect a millivolt meter to the plug VTVM at the rear of the panel (Hewlett Packard 412A millivolt meter or equivalent)

7.1.10 Place the "POWER SWITCH" to "ON" and allow the amplifier to reach thermal stability.

7.1.11 Set the amplifier gain control to the lowest range and adjust the external zero control R-1 for minimum reading on the millivolt meter (Front panel accessible , Reference manual). Record any residual offset.

7.1.12 Set the amplifier gain control to the highest gain position and adjust the internal collector zero control for the same offset recorded in Paragraph 7.1.11.

7.1.13 Repeat Paragraph 7.1.11 and 7.1.12 until the output remains the same on both ranges.

7.2 INPUT CURRENT ADJUSTMENTS

7.2.1 Set the amplifier to its maximum gain position, normally 1,000.

7.2.2 Connect a millivoltmeter or oscilloscope to the WIDEBAND terminals.

7.2.3 Record any slight offset observed on the scope or meter.

7.2.4 Switch the INPUT MODE selector to N-1K.

7.2.5 Adjust the "N" current control for the same offset recorded in Paragraph 3.1.11. Reference manual of the amplifier for the N-potentiometer.

7.2.6 Switch the INPUT MODE selector to P-1K.

7.2.7 Adjust the "P" current control. Reference Manual of the amplifier for the P-potentiometer.

7.3 COMMON MODE ADJUSTMENTS

7.3.1 Reference manual for functions and physical locations of the common mode components. (Maintenance and adjustments).

7.3.2 Set the ATTENUATOR for a fixed attenuation of 1000.

7.3.3 Connect a jumper between the black terminal of "GEN. INPUT" and the black terminal of "WB".

7.3.4 Set the vertical sensitivity of the oscilloscope to 5 volts/cm.

7.3.5 Adjust the oscillator (item 1.2) for 20 volts P-P at 60 Hz.

7.3.6 Connect the horizontal inputs of the oscilloscope to the "SCOPE HOR" jacks.

7.3.7 Switch the FILTER selector to 1 kHz.

7.3.8 Switch the INPUT MODE selector to NON INV.

7.3.9 Adjust the common mode amplifier (reference amplifier manual) for a minimum vertical deflection.

7.4 INPUT GAIN SYMMETRY

7.4.1 Reference manual for location of potentiometer

R25 - attenuator assembly of Series 3000 Amplifiers
R43 - attenuator of Series 2800 Amplifiers

7.4.2 STANDARD MODELS

7.4.2.1 Set the amplifier gain switch to X1000.

7.4.2.2 Switch the INPUT MODE selector to CM.

7.4.2.3 Switch the OUTPUT MODE selector to WIDEBAND.

7.4.2.4 Switch the FILTER selector to 1 kHz.

7.4.2.5 Switch the OUTPUT SELECTOR to AMP OUT.

7.4.2.6 Remove the jumper between the black terminal of "GEN. INPUT" and the black terminal of "WB".

7.4.2.7 Adjust the potentiometer of the amplifier for minimum deflection.

7.4.3 SPECIAL SINGLE ENDED UNITS

7.4.3.1 Remove the jumper between the black terminal of "GEN. INPUT" and the black terminal of "WIDEBAND".

7.4.3.2 Set the gain multiplier on the amplifier to the X1.0 position and the course gain to X1000. (V2 gain options)

7.4.3.3 If the input is equipped with a continuous gain vernier (X1 to X2.5) adjust same for minimum gain. If the unit has a $\pm$ 2% gain trimmer it should not be adjusted.

7.4.3.4 Adjust the "ATTENUATOR" for a fixed attenuation of X1000 and "GEN" to "GEN. INPUT"

7.4.3.5 INPUT MODE - NON INV

7.4.3.6 SOURCE UNBAL - SHORT

7.4.3.7 GUARD - ON

7.4.3.8 LOAD - OFF

7.4.3.9 OUTPUT MODE - WIDEBAND

7.4.3.10 FILTER - OFF

7.4.3.11 OUTPUT SELECTOR - NULL

7.4.3.12 Adjust the "NULL DET" for a null in the quadrature error.

7.4.3.13 The gain of the amplifier may be calculated as follows:

$$K = {}^{1}/_{h}$$

where K = amplifier gain

h = ratio of voltage output to input of the attenuator (the voltage to the input of the attenuator may be measured by switching the OUTPUT MODE selector to ATTEN IN (adjust the signal generator for 10 volts peak-peak at 100 cps).

7.4.3.14 Record the result

7.4.3.15 Switch the gain multiplier on the amplifier to the X0.01 position.

7.4.3.16 Set the ATTENUATOR for a fixed attenuation of X10.

7.4.3.17 Adjust R25 or R43 (reference manual) until the gain is equal to that recorded in Paragraph 7.4.3.14.

7.5 OUTPUT CURRENT LIMITERS

7.5.1 Set the amplifier gain control to the highest gain position (normally 1,000).

7.5.2 Set the "ATTENUATOR" for a fixed attenuation equivalent to the gain setting of the amplifier.

7.5.3 INPUT MODE - NON INV.

7.5.4 SOURCE UNBAL - SHORT

7.5.5 GUARD - ON

7.5.6 LOAD - 100 ohms for 100 ma outputs
1 K ohms for 10 ma outputs

7.5.7 OUTPUT MODE - WIDEBAND

7.5.8 FILTER - OFF

7.5.9 OUTPUT SELECTOR - ATTEN IN

7.5.10 Adjust the signal source until the display is 25 volts P-P.

7.5.11 OUTPUT SELECTOR - AMP OUT

7.5.12 Adjust the positive and negative limit potentiometers, R-17 and R-11 respectively, to a position where the positive and negative peaks

are just beginning to clip. Reference manual for the physical locations of R-17 and R-11.

For Series 2800, adjust R92 and R91 for current limit.

7.6 OUTPUT ZERO ADJUSTMENT

Dual output amplifiers have an additional zero control on the second output amplifier. This control is adjusted as follows:

7.6.1 INPUT MODE - SHORT

7.6.2 Connect a jumper from the black terminal of "GEN. INPUT" to the black terminals of "WB" and "VB".

7.6.3 SOURCE UNBAL - SHORT

7.6.4 GUARD - ON

7.6.5 LOAD - OFF

7.6.6 OUTPUT MODE - WIDE BAND

7.6.7 FILTER - OFF

7.6.8 OUTPUT SELECTOR - AMP OUT

7.6.9 Adjust the front panel zero control of the amplifier for a minimum reading. Record any residual offset.

7.6.10 OFFPUT MODE - VARIBAND

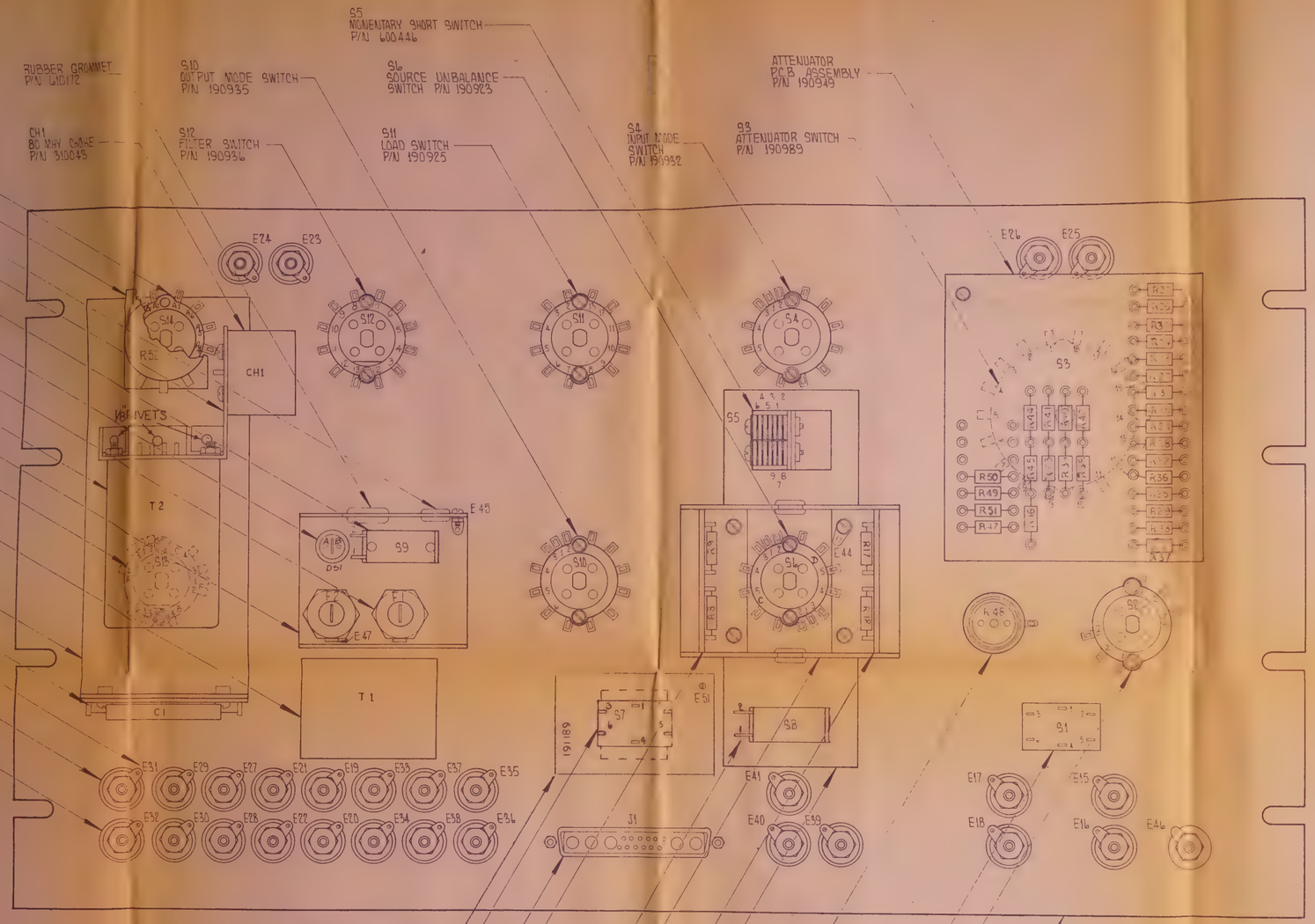
7.6.11 Adjust the output zero control of the amplifier for the same offset recorded in Paragraph 3.6.9.

7.6.12 Remove the jumpers connected in Paragraph 7.6.2.

8.0 DRAWINGS

Assembly 2195 Test Panel	191003
Schematic 2195 Test Panel	190912
Layout 2195 Test Panel	190916
PCB Assembly Attenuator	190949
Assembly Source Switch Board	190967
Assembly Power Supply Filter	190968
Test Cable 3000 & 2700 Amplifiers	191033
Test Cable 2600 Amplifiers	191034
Test Cable 2800 Amplifiers	191035

REVISIONS				
LTR	DESCRIPTION	BY	CHK	APP'D
1	S7 CHANGED FROM 3PST TO 2PST. SHIELD ADDED.	[illegible]	✓	✓
2				



2 POWER XFMR T1 PART NUMBER DETERMINED BY LINE VOLTAGE APPLICATION: (300006 - 117 V) (300027-220-240V) (300031-100V).

1. STAMP (INK) NUMBERS OF TERMINALS ON PANEL APPROX. AS SHOWN.

NOTES: UNLESS OTHERWISE SPECIFIED

	S 3055		
	2195 TEST PANEL		
NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:

DECIMALS	ANGLES	HOLE DIAMETERS
.X .030	0 30'	.004
.XX .020	FORMED 1 0°	.001
.XXX .010		

MATERIAL

FINISH

DRAWN	M. M. Tracy	8-23-68
CHECK	L. B. MULVEY	8-23-68
DESIGN		
MECH ENGR		
PROJ ENGR	L. B. MULVEY	8-23-68

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

2195 TEST PANEL ASSEMBLY

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	191003	2

SCALE NONE SHEET 1 OF 1

REVISIONS				
LTR	DESCRIPTION	DR	CHK	APPD
1	REVERSED CONNECTIONS TO S7-3 & S7-6	LBM	✓	✓
2	REVISED SWITCH CONNECTIONS-S2-S7-S8-S9	[illegible]	✓	✓
3	" " " -S7	[illegible]	✓	✓
4	R48 CHANGED TO 200Ω 1 SHUNT BY 27Ω R62	[illegible]	✓	✓

NOTE: S6 SECTIONS ARE CONCENTRIC

SOURCE UNBALANCE

INPUT MODE

ATTENUATOR (4 SECTIONS)

16 AWG WIRE

INPUT SELECTOR AUDIO GEN

INPUT SELECT INT AMP INPUT

INPUT SELECTOR

EXT AMP INPUT

ST SHIELD P/N191189

GUARD ON S8 OFF

FIXED

VARIABLE

VARIATION

OUTPUT MODE

NOTE: S11 SECTIONS ARE CONCENTRIC

CAPACITIVE LOAD

EXT. LOAD

RESISTIVE LOAD

LOAD SELECTOR

RATIOMETER UNIT

OUTPUT SELECTOR SW

AMP OUT

NULL

ATT IN

PHASE INV SW

NULL ADJ

FILTER

TO RATIOMETER

SHIELD BOX

AC POWER

F1 1A SB

CHASSIS GND.

WHITE

BLACK

WHT (300006B) RED (300027)

SEE NOTE 5.

WIDE BAND

VARI-BAND

WB/VB NULL

CM/WB CM/VB

EXT. LOAD

CHASSIS GND.

WB/VB

NULL

WIDE BAND

VARI-BAND

SCOPE HOR.

DECADE TRANS IN

DECADE TRANS OUT

SCOPE VERT.

AC RETURN

NOTES UNLESS OTHERWISE SPECIFIED

1. ATTENUATOR SWITCH SHOWN IN X1 POSITION.
2. LOAD RESISTORS R54 - R61 ARE 3W WIREWOUND.
3. ALL PRECISION RESISTORS ARE JOHNSON TYPE
4. ALL RESISTORS ARE ¼W CARBON 5%.
5. LINE VOLTAGE DETERMINES TRANSFORMER PART NUMBER. (300006/117V) (300027/220V) (300031/100V)

S 3055			
NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:

DECIMALS	ANGLES	HOLE DIAMETERS
X .030	0° 30'	±.004
XX .020	FORMED	.001
XXX .010	1° 0'	

MATERIAL

FINISH

DRAWN	M. McKeay	7-12-68
CHECK		7-18-68
DESIGN	R. B. Chester	8-8-68
ENGR		
ENGR		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

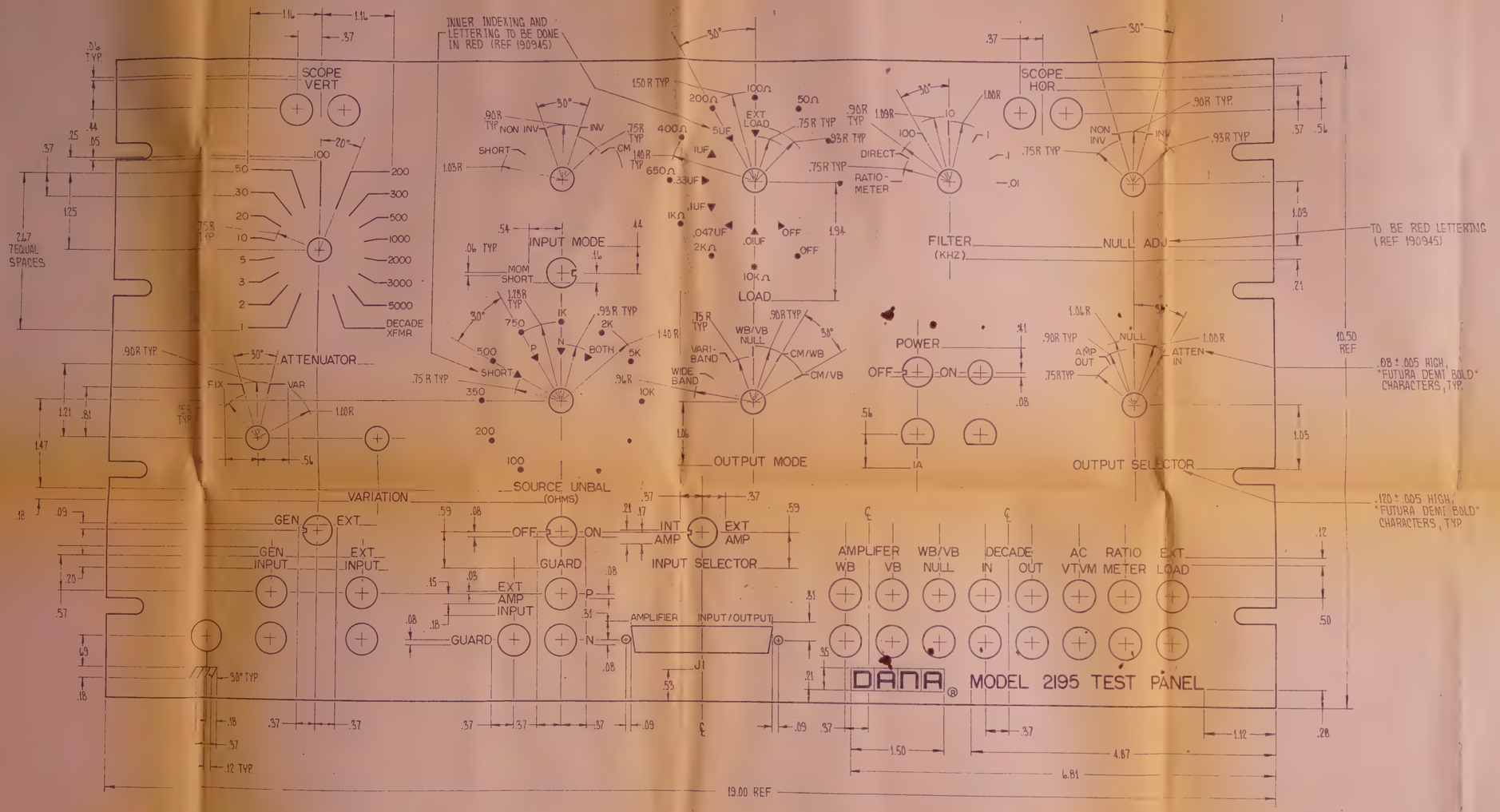
SCHEMATIC - AMPLIFIER TEST PANEL - 2195

SIZE	CODE IDENT NO	DWG NO.	REV
D	21793	190912	4

SCALE

SHEET 1 OF 1

REVISIONS				
LTR	DESCRIPTION	DR	CHK	APPD



6. ALL LINE WIDTHS TO BE .020 ± .003.
5. SILKSCREEN PATTERNS TO BE CENTERED ABOUT VERTICAL CENTER LINES OF HOLES AS SHOWN.
4. LETTER STYLE OF ALL CHARACTERS AND NUMERALS TO BE "FUTURA DEMI BOLD".
3. ALIGN SCREENS TO HOLE CENTERS (WHERE APPLICABLE).
2. SCREENING TO BE IN BLACK, RED WHERE SPECIFIED.
1. PRIME AND PAINT PER FED STD # 595 PER DANA BLUE COLOR CHIP SEMI-GLOSS BAKING EPOXY PAINT.

NOTES UNLESS OTHERWISE SPECIFIED

S 3055			
190945	6296	1	1
NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:

DECIMALS	ANGLES	HOLE DIAMETERS
.X .030	0 30'	.004
.XX .020	FORMED 1 0°	.001
.XXX .010		

MATERIAL

FINISH

DRAWN	M. McKeag	7-23-68
CHECK		
DESIGN		
MECH ENGR		
PROJ ENGR		

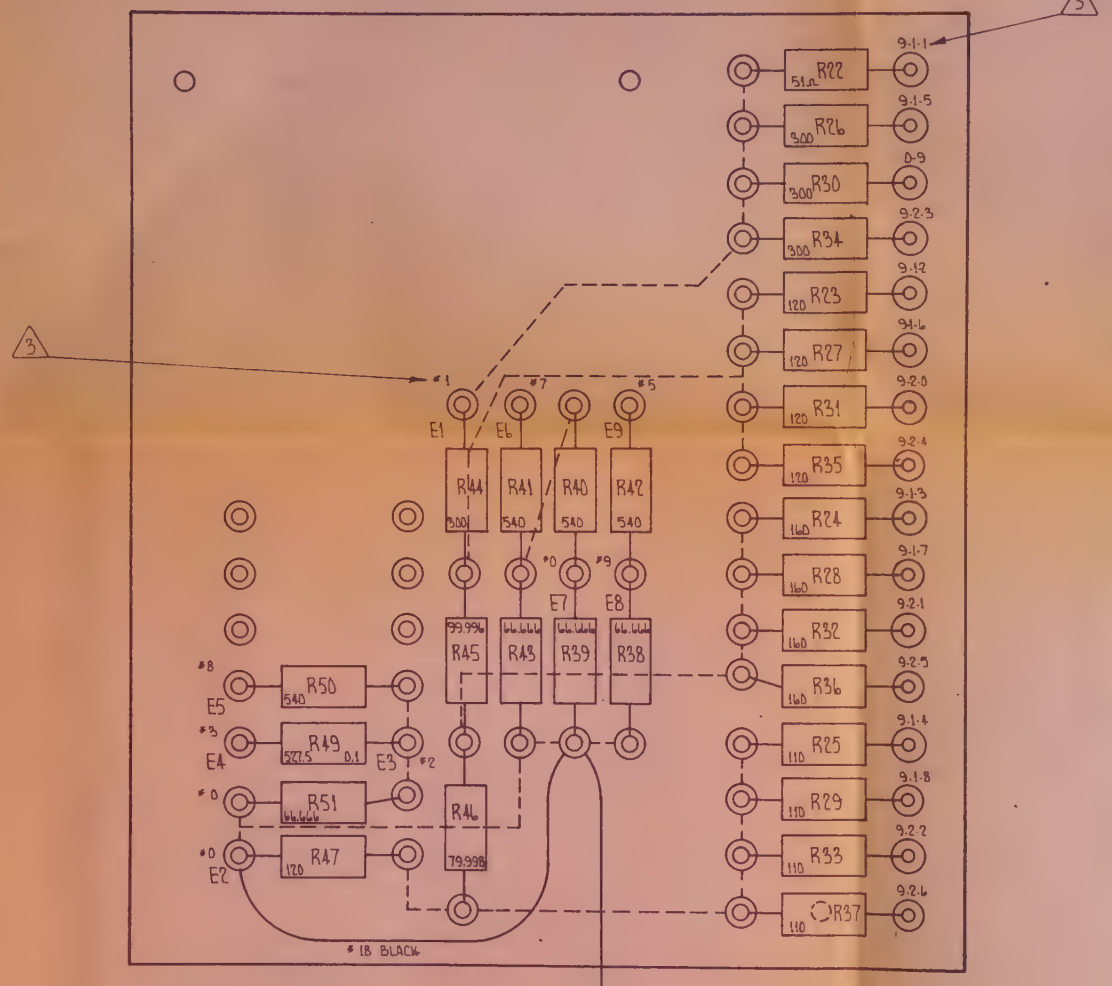
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

2195 TEST PANEL LAYOUT

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	190916	

SCALE FULL SHEET 1 OF 1

REVISIONS				
LTR	DESCRIPTION	DR	CHK	APPD
2	ADDED WIRE COLOR CODE & RESISTOR VALUES	M.Mc. 10-18-68		
3	CHANGED P/N OF RESISTORS FROM-020492 TO 020477 , FROM 020480 - TO 020471	M.Mc. 11-12-68		



S1-4

REF DES OR ITEM	P/N	DESCRIPTION	QTY	REF DES OR ITEM	P/N	DESCRIPTION	QTY
R22	000510	51Ω 1/4W 5%	1	R47	020493	120Ω 1/4W .01%	1
R23	000121	120Ω		R49	020472	527.5Ω 1/4W 0.1%	
R24	000161	160Ω					
R25	000111	110Ω		R51	020477	66.666Ω 1/4W .01%	1
R26	000301	300Ω					
R27	000121	120Ω					
R28	000161	160Ω					
R29	000111	110Ω					
R30	000301	300Ω					
R31	000121	120Ω					
R32	000161	160Ω					
R33	000111	110Ω					
R34	000301	300Ω					
R35	000121	120Ω					
R36	000161	160Ω					
R37	000111	110Ω 1/4W 5%	1				
R38	020477	66.666Ω 1/4W .01%	1				
R39	020477	66.666Ω					
R40	020471	540Ω					
R41	020471	540Ω					
R42	020471	540Ω					
R43	020477	66.666Ω					
R44	020476	300Ω					
R45	020475	99.996Ω					
R46	020494	79.998Ω 1/4W	1				

3. WIRE COLOR CODE
2. HIGHEST REF. DES. USED: R51.
1. SCHEMATIC REF. 190912

NOTES: UNLESS OTHERWISE SPECIFIED

	S 3055		
191057	2195	1	1
NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:

DECIMALS	ANGLES	HOLE DIAMETERS
.X .030	0 30'	±.004
.XX .020	FORMED	
.XXX .010	1 0'	.001

MATERIAL

FINISH

DRAWN	M. McKray	8-1-68
CHECK		
DESIGN		
MECH ENGR		
PROJ ENGR		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ATTENUATOR PCB ASSY.

SIZE	CODE IDENT NO	DWG NO.	REV
C	21793	190949	3

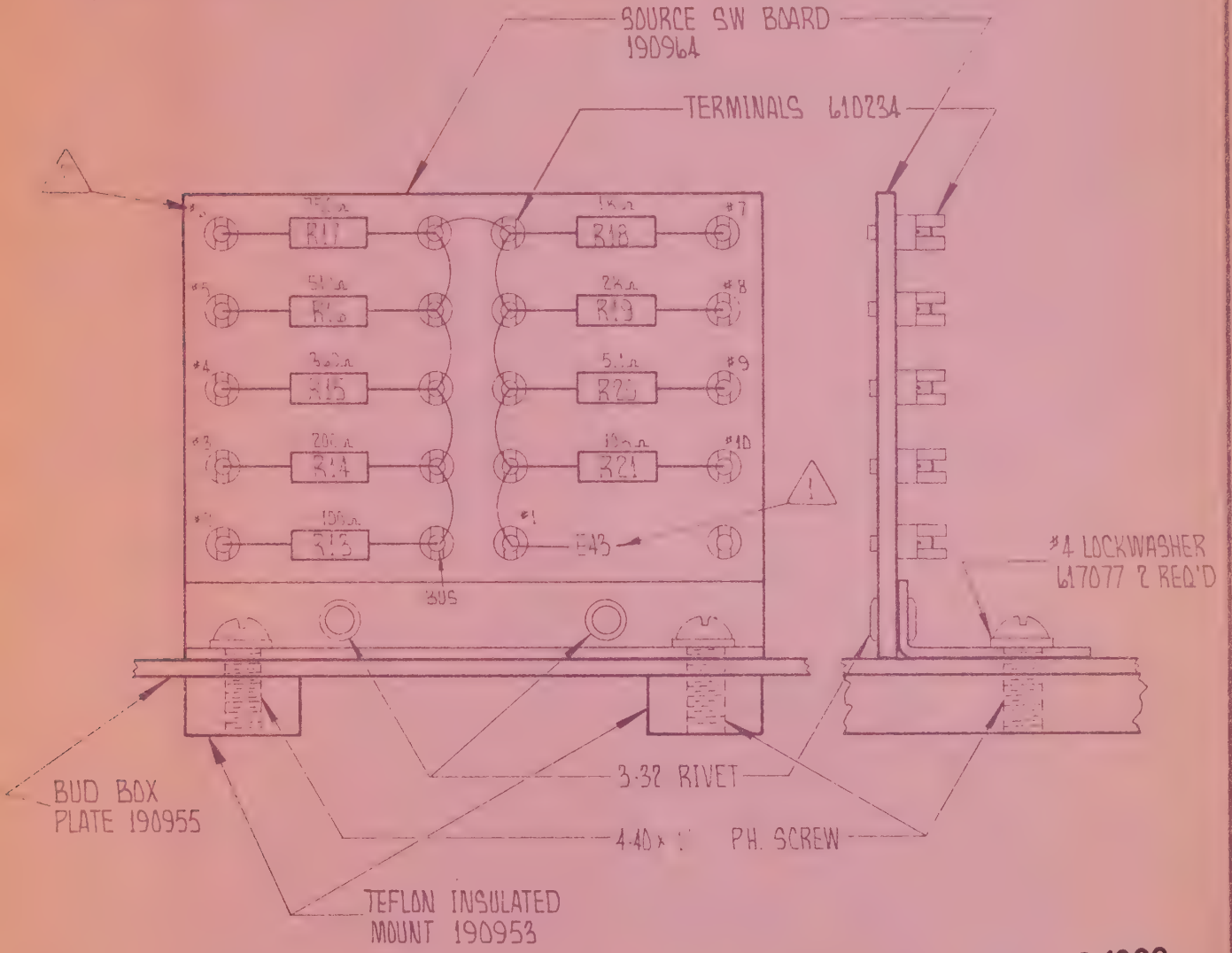
SCALE 2/1 SHEET 1 OF 1

DRAFTING USED BY GRAPHIC CONTROLS CORPORATION Brooklyn New York REPROVEL NO 440M

APPLICATION		REVISIONS			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
		2	ADDED RESISTOR VALUES	M.M. 9-30-68	
		3	ADDED COLOR CODES & JUMPERS	M.M. 10-18-68	

NOTE: 1. E43 IS FROM S6-3A-1

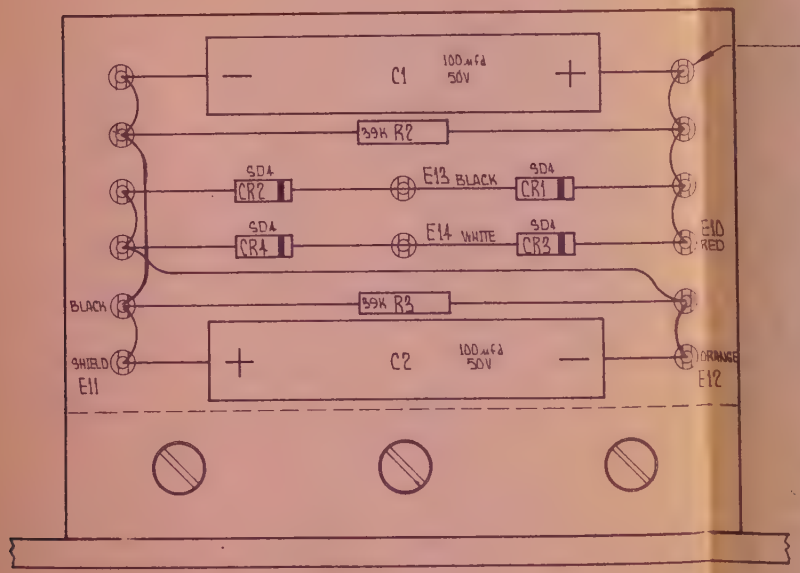
2. WIRE COLOR CODE.



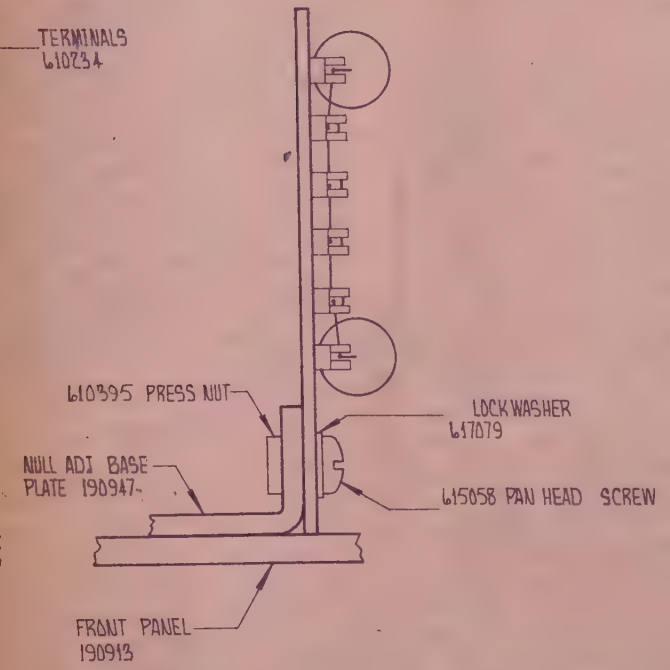
APR 3 1969

UNLESS OTHERWISE SPECIFIED DIM. ARE IN IN. TOL ON	CONTRACT NO. S3055	DANA LABORATORIES INC. IRVINE, CALIFORNIA			
DEC. .X .030 .XX .020 .XXX .010	DR. M M. Kray 8-5-68	2195 TEST PANEL SOURCE SW BOARD ASSY.(B)			
MATERIAL	CHK.				
FINISH	APPD.	SIZE A	CODE IDENT NO. 21793	DWG NO. 190967	REV 3
	ENGR.	SCALE 2/1	WT.	SHEET 1 OF 1	

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
2	ADDED VALUES & WIRE COLOR CODES CHANGED P/N OF NUT, WASHER & SCREW FROM #4 TO #6	M. McKray 10-18-68	
3	ADDED JUMPERS TO E12 & E11.		



TERMINALS 610234



	S3055		
191003	2195 TEST PANEL		
NEXT DWG	USED ON	NEXT ASSY	QTY REQD
APPLICATION			

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ±.1, .XX ±.02, .XXX ±.010
ANGLES ±30' FIRMEL
HOLE FROM TERC ±.0
MATERIAL
FINISH

DRAWN	M. McKray	8-5-68
CHECK	J.B. Mathews	8-7-68
DESIGN		
MECH ENGR		
PROJ ENGR	C.J. Mackey	8-8-68

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

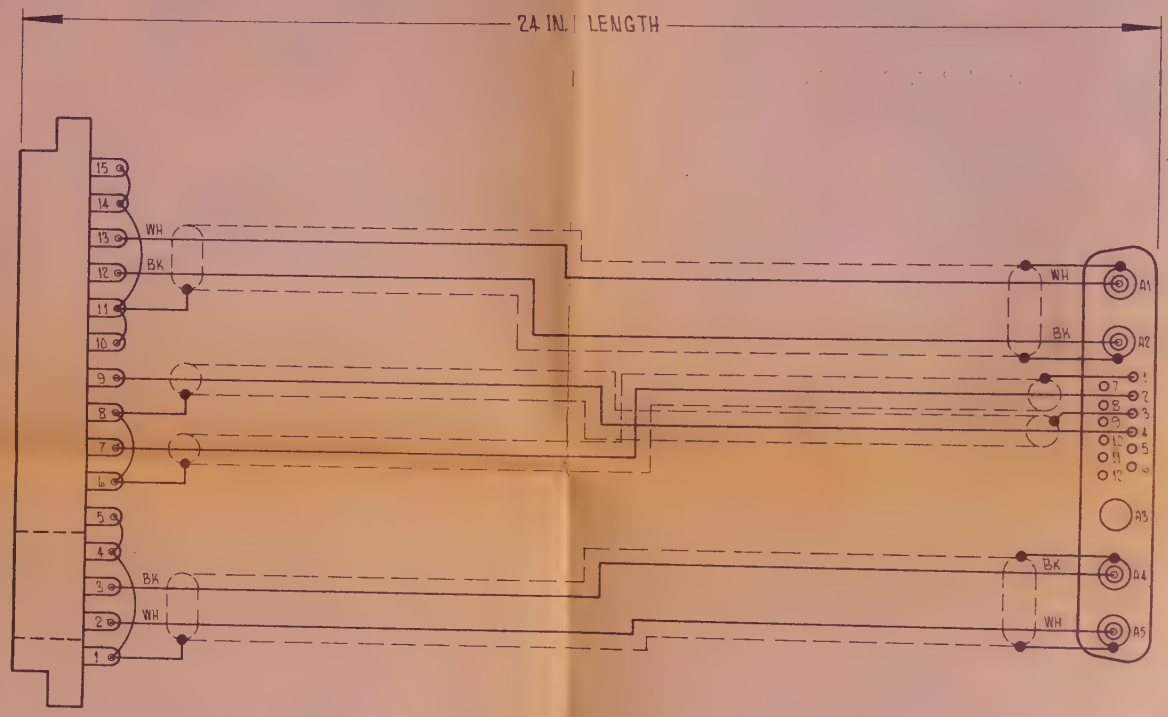
2195 TEST PANEL POWER SUPPLY FILTER ASSY.

SIZE	CODE IDENT NO	DWG NO	REV
B	21793	190968	3

SCALE 2/1 SHEET 1 OF 1

DIES UNLESS OTHERWISE SPECIFIED

REVISIONS				
LTR	DESCRIPTION	DR	CHK	APPD
2	ADDED 610183, NYLON CLAMP TO PARTS LIST	M. Mc 10-16-68		
3	CHANGED LENGTH FROM 15.00 TO 24.00, ADDED TWO MORE CONN HOODS, ADDED BLACK VINYL TUBING	M. Mc. 11-14-68		



P/N	DESCRIPTION	QTY
600448	CONNECTOR	1
600449	HOOD	1
450227A	HOOD	1
450354	SPACER, CONN. MTG.	2
600098	P.C. EDGE CONN	1
600250	KEY CONNECTOR	2
610019	RIVET, 1/8 x 5/32	6
615041	SCREW DPH, 4.40 x 3/16	2
615045	SCREW PPH, 4.40 x 7/16	2
617077	WASHER, INT. LOCK	2
617102	WASHER, FLAT LIGHT	4
600057	CONNECTOR, INSERT, MALE	4
610183	NYLON CLAMP	1
	BLACK VINYL TUBING	A/R

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
	S 3055		
APPLICATION	2195 TEST PANEL	QTY REQD	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:

DECIMALS	ANGLES	HOLE DIAMETERS
.X .030	0° 30′	.004
.XX .020	FORMED	
.XXX .010	1 0′	.001

MATERIAL

FINISH

DRAWN	M. McKray	8-30-68
CHECK		
DESIGN		
MECH ENGR		
PROJ ENGR	L B MULVEY	8-30-68

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

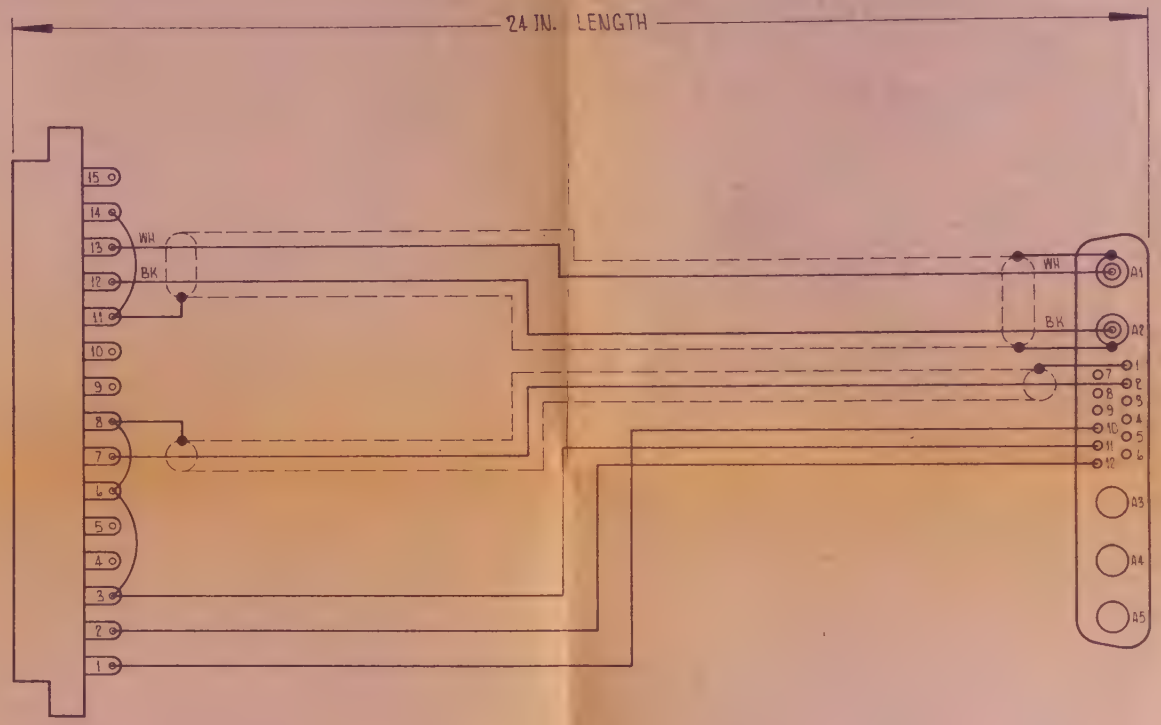
3000 & 2700 AMPLIFIER TEST CABLE

SIZE	CODE IDENT NO	DWG NO.	REV
C	21793	191033	3

SCALE NONE SHEET 1 OF 1

DRAFTING MEDIA GRAPHIC CONTROLS CORPORATION Brooklyn New York REPROVEL NO 440M

REVISIONS				
LTR	DESCRIPTION	DR	CHK	APPD
2	ADDED 2 MORE CONN. HOODS & NYLON CLAMP. LENGTH WAS 22 IN. BLK VINYL TUBING IS 24.00 IN. 14-68			



P/N	DESCRIPTION	QTY
600448	CONNECTOR	1
600449	HOOD	1
450227A	HOOD, CONNECTOR	1
450354	SPACER, CONN, MTG.	2
600098	P.C. EDGE CONN.	1
600250	KEY - CONNECTOR	2
610019	RIVET, 1/8 x 5/32	6
615041	SCREW, PPH 4.40 x 3/16	2
615045	SCREW, PPH 4.40 x 7/16	2
617077	WASHER, INT. LOCK	2
617102	WASHER, FLAT, LIGHT	4
600057	CONNECTOR, INSERT, MALE	2
W101B3	NYLON CLAMP	1
	BLACK VINYL TUBING	A/R

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
	S 3055		
	2195 TEST PANEL		
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:

DECIMALS	ANGLES	HOLE DIAMETERS
.X .030	0 30'	.004
.XX .020	FORMED	.001
.XXX .010	1 0'	

MATERIAL

FINISH

DRAWN	M. McKray	8-30-68
CHECK		
DESIGN		
MECH ENGR		
PROJ ENGR	L B A - [illegible]	9-30-68

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

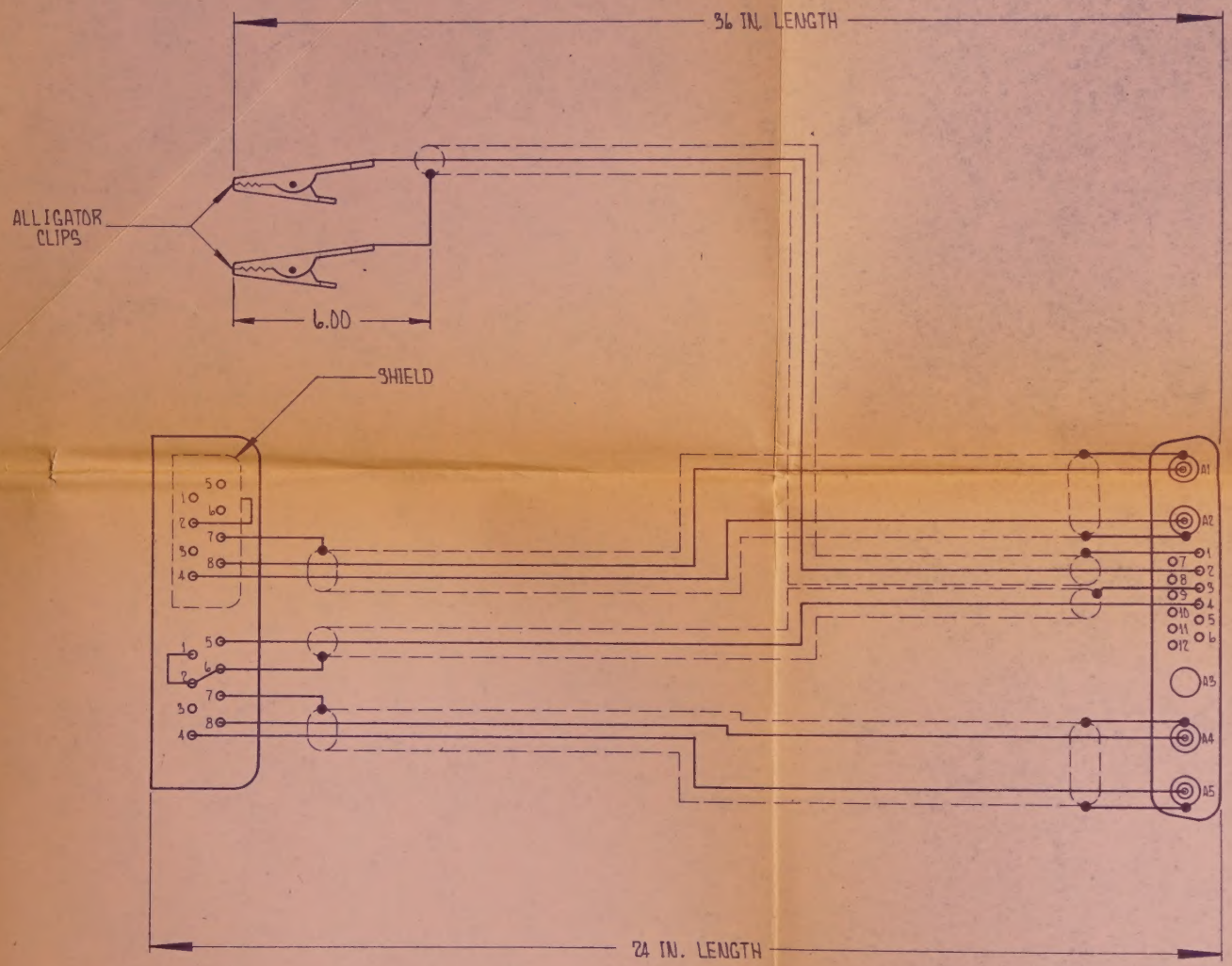
2600 AMPLIFIER TEST CABLE

SIZE	CODE IDENT NO.	DWG NO.	REV
C	21793	191034	2

SCALE NONE | SHEET 1 OF 1

DRAFTING MEDIA GRAPHIC CONTROLS CORPORATION Brooklyn New York REPROVEL NO 440M

REVISIONS				
LTR	DESCRIPTION	DR	CHK	APPD
2	CHANGED CABLE LENGTH FROM 20.00 TO 24.00 UPDATED PARTS LIST	M.Mc. 11-14-68		



P/N	DESCRIPTION	QTY
600057 600448	CONN - INSERT, MALE CONNECTOR	4 1
~~600449~~	~~HOOD~~	~~1~~
191188	COVER - CONN	1
452409C	PHETNOLIC CONN. MTG. CORD	1
A52479	SCREW CAPTIVE CORD SET	1
600032	LUG, SOLDER	1
600106	MINICLIP, (CAD PLT)	2
600011	INSULATOR, RED	1
600012	INSULATOR, BLACK	1
600296	CONN, RECPT	1
600345	CONN, 8-PIN	1
610040	GROMMET, RUBBER	1
610120	BUSHING	1
610183	NYLON CLAMP	1
610337	STANDOFF	2
610338	STANDOFF	2
610355	SPACER	1
610541	SCREW, DPH. 4-40-3/16	2
615043	SCREW, DPH. 4-40x 5/6	10
615543	SCREW, PFH, 4-40x 3/8	2
617004	HEX NUT, 4-40	2
617007	HEX NUT, 10-32	6
617102	WASHER, FLAT	3
617103	WASHER, FLAT	1
617077	WASHER, INT. LOCK	12
	BLACK VINYL TUBING	A/R

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT DWG	USED ON	NEXT DWG	FINAL ASSY
	S 3055		
	2195 TEST PANEL		
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:

DECIMALS	ANGLES	HOLE DIAMETERS
.X .030	0° 30'	+.004
.XX .020	FORMED	−.001
.XXX .010	1° 0'	

MATERIAL

FINISH

DRAWN	M. McKray	8-30-68
CHECK		
DESIGN		
MECH ENGR		
PROJ ENGR	L. B. MULVEY	8-30-68

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

2800 AMPLIFIER TEST CABLE

SIZE	CODE IDENT NO.	DWG NO.	REV
C	21793	191035	2

SCALE NONE | SHEET 1 OF 1

DRAFTING MEDIA GRAPHIC CONTROLS CORPORATION Brooklyn New York REPROVEL NO. 4604

DANA™

MP MASTER

MA31093